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I, LEANNE MYNOTT, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PP 7827 for a patent by BRADBURY FRANK GOLLEDGE filed on 22 December 1998.

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TEAM LEADER EXAMINATION
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Patents Act 1990

PROVISIONAL SPECIFICATION

Invention Title: STRUCTURAL FRAMEWORK MEMBER FOR SUSPENDED FLOOR SYSTEMS

The invention is described in the following statement:

STRUCTURAL FRAMEWORK MEMBER FOR SUSPENDED FLOOR SYSTEMS

The present invention relates to improvements in elongated structural members for use in load bearing frameworks that form a floor system and, in particular, to steel structural members which are cold formed by roll forming and which are ideally joined together and to connecting structural elements, and flooring, linings and the like, by nailing. The framework of the present invention is primarily used in relation to floor systems in domestic housing, but can be equally applicable to many different types of applications and to many different types of buildings.

BACKGROUND TO THE INVENTION

Conventional floor framing systems comprise: bearers and joists, which run transverse to each other, and flooring, being of either sheet or board running substantially transverse to the floor joists. For floor systems that require joists to span long distances, such as in the case of an elevated floor where joists span across supporting wall structures, it is typical to employ trussed floor joists that comprise two parallel chord members which are interconnected with web members. In such instances, known trussed floor joist assemblies have the following advantages: services such as plumbing, electrical and other cables, air conditioning ducts, etc. can pass transverse to the joists ameliorating the need to drill through a solid joist member or without protruding through the ceiling line of the space below; higher strength to weight ratio resulting in overall joist assemblies that weigh less than solid joist members with comparative spanning capabilities. Their light weight nature makes it therefore easier to construct.

Known frameworks exist that comprise timber chord members interconnected via steel webs which have integral nail plate areas formed into their extremities. These nail plate areas fasten into the side faces of the timber chord members, thus requiring attachment of webs to both sides of the framework. The effective nail plate area is determined by the depth of the timber chord member. And the length of the nail plate area is limited by design factors relating to the distance between webs and the eccentricity of load transferred into the web member. To this end, the size of the nail plate area required to support the necessary loads can govern the material content in the webs themselves, or conversely, that the material content in the web determines the allowable load that can be transmitted by the web members. It is thus desirable to firstly have web members loaded concentrically and secondly,

to provide adequate connection capacity whilst allowing economic structural design of web members.

To this end it is also desirable to design the web and chord material to be equally as strong in the connection. In known joist frameworks that comprise cold formed steel structural members, economy of web members has been achieved by reducing the gauge, or thickness, of the web members. However, this diminishes connection capacities between the web and chord members. It is desirable to have both efficient structural members whilst maximising the capacity of connections between the members.

Known joist frameworks that comprise cold formed steel structural members are typically formed from conventional Cee section members such that the web members nest in the chord members, or of "top hat" chord members with various different web sections being able to nest between webs of the top hat section. All known prior art that comprises cold formed steel members is dependent upon substantially similar overall dimensions between the chord and the web members to enable nesting. This nesting feature of known prior art facilitates structural joints through the installation of a fastening means between adjacent surfaces of the members: flange element to flange element in the case of Cee sections, and between each of the web elements of a top hat chord member and an adjacent flange element of the web member. By nature of the joints described above, economic fastener installation, whether by self-drilling screws, welding, riveting or by integral fastening means such as clinching, must be performed on each side of the framework. Whilst this enables the use of economic fastening means through fixing adjacent surfaces, this results in an inefficient fabrication process. Also, in requiring a minimum of one fastener each side of the framework on a particular web to chord joint, the efficiency of the joint overall, which requires a minimum of two fasteners is diminished because the load transmitted may only require the strength of one connection.

Therefore it is desirable to have optimal and the lowest possible number of connections per unit length of framework. There will be a significant benefit in the cost and speed of manufacture to install a single fastener that is of sufficient length to penetrate both sides of the joint from the one side of the framework. In the case of a framework comprising Cee sections such a fastener, by necessity, will protrude from the overall width of the framework, increasing the potential for injury and increasing the fastener cost. In the instance of a top hat

chord member, such a fastener may still be contained within the overall width of the framework. In all known prior art relating to cold formed steel frameworks, the overall width of the assembly is substantially controlled by the depth of the web element of the chord members, thus establishing a similar size for the web members.

The chord and web members of a trussed floor joist have different functions and design requirements and as such it would be desirable if within feasible geometrical parameters each were designed optimally to suit its separate function. Therefore it is desirable to optimally design each section for its intended purpose

It is desirable to minimise capital expenditure on manufacturing equipment, particularly by utilising one roll former to produce both chord and web members. Known timber frameworks that comprise steel web members require different processes to produce the chord and web members.

The two aspects in the design philosophy of economical and material efficient sections are maximising the strength to weight ratio and minimising the deflection to weight ratio, that is, maximising the second moment of area and minimising the material content. In a parallel trussed framework the second moment of area can be simplified to:

$$I_{xx} = \frac{1}{2}.A.d^2$$

where: A = cross–sectional area of chord members

d = distance between centroids of chord members

To maximise I_{xx} either the cross–sectional area of the chord members, A, or the distance between the centroids of the chord members, d, can be increased, but clearly what has most impact is d. The distance between the centroids of the chord members, d, must alway be less than the overall depth of the truss, D, which is generally standardised according to building dimensional parameters. Therefore, it is desirable to have the centroid of the chord member as close to the extremity of the depth dimension of the truss as possible, that is, to make d/D as close to unity as possible. $y_c = \frac{D-d}{2}$

In known timber parallel trussed frameworks, where the chord member is a rectangular section of depth and breadth $D \times B$, $y_c = \frac{B}{2}$, or where D defines the width of the framework

and B, the depth of the side face which the nail plate areas of the web members attach. In this case $d = D - B$.

In known steel parallel trussed frameworks comprising conventional Cee–section chord members, the centroid, by nature of the section, is closer to the extremities of the framework than is the case for timber chord members.

In known steel parallel trussed frameworks comprising conventional balanced “top–hat” chord members, the centroid is close to half the depth of the section, so has similar relationships as the timber trussed framework above. The same is true for frameworks comprising Zed–section chord members.

In each instance above, economy of section property to material content can be maximised, within constraints of section geometry and fastening means, by increasing the overall width of the framework. However in the case of steel frameworks comprising Cee or Top–hat sections, the greater the width of the chord member, the greater the width of the web members required to nest in the members and as a consequence becomes materially inefficient. Top–hat chord members that are sized to suit an efficient web member lose width across the top face and require increased material at the open end of the section, which results in lost section balance and moving the centroidal axis further from the extremities of the framework.

All known cold formed structural steel frameworks comprise chord members that have a continuous element that forms the extremity and defines the depth of the framework. Therefore it is an object of the present invention to provide a chord member that has sufficient width that forms the extremities of the framework and concentrating the material content of the chords at the extremities of the framework, thus maximising the section property of the framework, and, providing elements that enable the use of web members that are not substantially the same width as the width of the extreme element of the chord member.

Known cold formed structural steel frameworks that comprise chord members that have a single layer of material at the extremities of the framework do not provide adequate restraint of nails used to attach flooring. It is therefore desirable to provide such restraint within the elements of the chord members.

Known timber structural framework members require blocking in situations where they butt into or run through intermediate structural beams, or bearers. It would therefore be desirable to maximise the clear distance between the chord members of the structural framework members such that beams can fit neatly between them, or to provide an efficient means of butting framework members into a beam member of the same depth Another reason blocking is used is to provide a suitable base for fixing flooring and ceiling linings.

OBJECT OF THE INVENTION

The present invention has been conceived out of the need to provide a structural framework and components thereof, which lowers the cost of the structural framework in floors, by maximising section property to mass ratio, lowering the acquisition costs of the manufacturing equipment to produce the members, and lowering the required cost and time of manufacture by providing a method of assembly from one side of the framework. It is the object of the present invention to provide a structural framework, particularly a floor framing system, including the types of components used and their method of assembly and construction, which substantially overcomes or ameliorates the disadvantages with known systems as mentioned in the background. At the very least the object of the present invention is to provide an alternative to known systems.

DISCLOSURE OF THE INVENTION

According to the present invention there is provided a floor framing system for a building, said floor framing system comprising a plurality of elongate load bearing framework members which are supported by the building, or foundations thereof, and which support flooring material and in some instances ceiling linings or battens or other like ceiling framing system, each said elongate load bearing framework member including at least two parallel elongate structural members (chord members), wherein the element that forms the extremity of depth is discontinuous, and at least one structural web member therebetween, wherein its width is substantially different to the overall width of the parallel elongate structural members whilst being aligned substantially centrally across the width of the parallel elongate structural members.

In another aspect of the present invention the elongate structural members that form the extent of the framework members are not parallel but are angled to each other such as to form triangular or trapezoidal framework geometries.

In one aspect of the present invention the chord members have holes in the central flange element such that the web elements thereof enclose the flange elements of the web members, with the resulting adjacent mating surfaces providing for a connection means between the members. This preferred embodiment may comprise a double web joined such that it forms a "Vee" and which is flexible about the bend, thus reducing the number of individual components, allowing installation of two webs at the same time, providing for different web angle arrangements, and allowing the installation of the webs between the adjacent chord member elements whilst remaining firmly constrained in the assembly jig. A preferred embodiment of the web member of this aspect of the present invention comprises abutting flange lip stiffeners that are curled, each one in opposing crests and valleys, such that when a load is applied in the direction across the lip stiffeners, they do not lap or slide over each other, resulting in local distortion of the section.

In another aspect of the present invention the web members have their web elements notched at the extremities such that the flange elements of the web members enclose the web elements of the chord members, with the adjacent mating surfaces providing for a connection means between the members. This preferred embodiment allows either individual or joined web members, whether a double web or a multiple greater than one, to be installed into the framework by sliding from one end along the chord members to the required location. At either a bend in a multiple web component member, whereby the continuous flange elements of the web member nest over the webs of the chord member as described above, or when the free ends of adjacent web members are lapped at the junction with the chord member, only one fastening means is required to adequately form the joints. This preferred embodiment of the web member is sufficiently similar in cross-section to the chord member such that they can both be manufactured by the same equipment.

In the preferred form the chord members resemble an inverted top-hat section and the web members form in the structural framework member is zig-zag like. The depth of the structural framework members can vary according to design and geometrical requirements, but in a

floor system comprising a plurality of structural framework members the depth is substantially consistent.

In the preferred form the chord members comprise extended and over-bent flange stiffening elements that act as stabilisers for connection means such as in the fixing of flooring material.

In the preferred form the floor system that comprises a plurality of structural framework members is stiffened by at least one structural stiffening member oriented substantially perpendicular to the length of the elongate structural framework members. In another preferred form this stiffening member comprises the same chord and web members of the plurality of structural framework members.

In the preferred form the distance between the chord members of the structural framework member is substantially the same as the overall depth of transverse beams, stiffening members and the like, such that it is not necessary to block out and/or cut or notch the chord members, or provide brackets for fixing to beam flanges. In another preferred form the beam member is a composite of more than one of the said framework members whereby the entire floor system is of the same depth without blocking and with substantially consistent properties between joist and beam members in relation to fixing of flooring and ceiling linings.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described with reference to the drawings in which;

Fig. 1 is a perspective view of a elongate structural framework member of a preferred embodiment;

Fig. 2 is a section view A-A of the chord member of the elongate structural framework member in Fig. 1;

Fig. 3 is a perspective view of the chord member of the elongate structural framework member in Fig. 1;

Fig. 4 is a plan view A of the chord members of the elongate structural framework member in Fig. 1 showing a preferred notching arrangement;

Fig. 5 is a perspective view of a preferred embodiment of the web member of the elongate structural framework member in Fig. 1 showing a preferred notching arrangement;

Fig. 6 is a perspective view of another preferred embodiment of the web member of the elongate structural framework member in Fig. 1 showing curling of the flange lip stiffeners;

Fig. 7 is a section view B-B of the web member of the elongate structural framework member in Fig. 1;

Fig. 8 is an side view of a flexibly joined double web member of the elongate structural framework member in Fig. 1;

Fig. 9(a) is a perspective view of another preferred embodiment of a web member;

Fig. 9(b) is a detail showing the connection of the web member of Fig. 9(a) to a chord member;

Fig. 10 is a section view C-C of the web member of Fig. 9.

Fig. 11 is a side view detail of a preferred embodiment of the connections at the end of an elongate structural framework member;

Fig. 12 is an end view detail of a preferred embodiment of the connections at the end of an elongate structural framework member;

Fig. 13 is a detail showing an embodiment of a transverse stiffening member and fixing to an elongate structural framework member;

Fig. 14 (a) & (b) are section views D-D of preferred embodiments of a detail of Fig. 13;

Fig. 15 is a view B detail of Fig. 14(b) showing an end notch of a vertical web member;

Fig. 16 is a partial end view of an elongate structural framework member showing fixture to wall support structures;

Fig. 17 is a partial sectional view of an elongate structural framework member showing fixture of flooring material to the top chord member;

Fig. 18 is similar to Fig. 17, but shows a butt joint of the flooring material;

Fig. 19 is a plan view showing fixture flooring material to the top chord, particularly staggering of the fastening means;

Fig. 20 is a partial sectional view of an elongate structural framework member showing fixture of ceiling lining to the bottom chord member;

Fig. 21(a) is a perspective view of a clip that can be used for centre fixing of ceiling lining to the bottom chord member; and

Fig. 21(b) is similar to Fig. 20, but shows centre fixing of ceiling linings

BEST MODE OF CARRYING OUT THE INVENTION

The elongate structural framework member 1 as shown in Fig. 1 is formed as a parallel chord truss comprising a pair of parallel elongate structural members 3(a) and 3(b) with a web structure therebetween which comprises a vertical end web 2(a) and flexibly joined double web 2(b), all of which are preferably formed from cold rolled steel.

In the preferred embodiment of Fig. 1 a vertical end web 2(a) is joined to the top chord 3(a) by inserting into a half-notch 5 at one end, and to the bottom chord 3(b), where it is adjacent the end of a diagonal web 2(b), by inserting into a full notch at the other end. At junction of two adjacent diagonal webs 2(b), or the apex of the bend in the case of a flexibly joined double web, a full notch 4 provides the means for joining to the chords 3(a) and 3(b). Fig. 4 shows the relative orientation of the notches for top 12 and bottom 11(a) and 11(b) chords, and the preferred pitch relationship. In this instance at an end 13 of the truss the notch 11(b) in the bottom chord is a half-notch, whilst the notch 12 is a full notch.

The joint between a web 2(a)/2(b) and a chord 3(a)/3(b) of one preferred embodiment Fig. 12 is formed by the flange elements 15(a) and 15(b) of the web member nesting within the web elements 7(a) and 7(b) of the chord member such that the inside surfaces 7(a) and 7(b) of the chord member butt against the outside surfaces 15(a) and 15(b) of the web member. The joint between a web 43 and a chord 3(a)/3(b) of another preferred embodiment Fig. 9(b) is formed

between a web 43 and a chord 3(a)/3(b) of another preferred embodiment Fig. 9(b) is formed by the web elements 7(a) and 7(b) of the chord member nesting within the flanges of the web member such that the inside surfaces 19(a) and 19(b) of the web member butt against the outside surfaces 7(a) and 7(b) of the chord member. When the fastening means 24 is installed in either of these preferred embodiments, it provides a shear connection between the members at two distinct points along the shank 44 and 45.

In the preferred embodiment of the web member of Fig. 5 the flanges are notched 14 at the midpoint such that when bent at 18 it forms a joined double web member that has flexibility around the bend axis.

Another preferred embodiment of the web member of Fig. 5 is shown in Fig. 6 where the lip stiffeners 17(a) and 17 (b) are curled in opposing fashion forming a rigid member, particularly for the purpose of installing connection means across the member as is the case in web / chord joints such as shown in Fig. 12.

In the preferred embodiment of the web member of Fig. 9(a) and Fig. 10, instead of notching the flanges, the entire web member 43 is bent at 22 into a Vee form that represents a double joined web. The ends of such a double web are notched 23 to enable nesting over the web elements of the chord member as described above and shown in Fig. 9(b). The bend 22 is formed such that it also nests over the web elements of the chord member in the way described, thus allowing a single fastener to fix the members. Such a configuration of the web member 43 also provides a means for installing webs by sliding along the chord members 3(a) and 3 (b) to the position required. The cross-section of the web member of Fig. 10 is substantially similar to the chord cross-section, thus enabling manufacture of both sections from the same roll former.

A plurality of elongate structural framework members 1 can be tied to a transverse stiffening member 25 as shown in Fig. 13. A vertical web member 26(a)/26(b) is joined to the outside surface of the web element 7(a)/7(b) of the chord member 3(a) by fastening means 26(a) or 26(b) as shown in section D-D of Figs. 14(a) and 14(b) respectively. View B of Fig. 15 shows how the end of the vertical web member 26(b) is notched to provide the joint shown in Fig. 14(b), where the fastening means 30 penetrates through the chord at 46. The transverse

stiffening member 25 is joined to the vertical web member 26(a)/26(b) by fastening means 27 and to the chord member 3(a) by fastening means 28.

In Fig. 16 the elongate structural framework member 1 is joined to the supporting wall structure 32 by fastening means 31 installed through the lip elements 9(a)/9(b) and flange elements 10(a)/10(b) of the bottom chord member 3(b).

Flooring material 33 is attached to the top chord member 3(a) of the elongate structural framework member 1 as shown in Figs. 17, 18 and 19 by fastening means 34, preferably nails, which penetrate the flange elements 10(a)/10(b) and lip elements 9(a)/9(b) and necessary adhesive 35. The lip elements 9(a)/9(b) provide support for the fastening means 34 at 37. A butt joint 36 is shown in Fig. 18, where one flooring sheet or board 33 is attached to one flange 10(a) of the top chord member 3(a) and the abutting flooring sheet or board 33 is attached to the second flange 10(b) of the top chord member 3(a). Intermediate fixing 38 of floor sheeting 33 is staggered across the two flange elements 10(a)/10(b) of the top chord member 3(a).

Ceiling linings 41 can be attached to the bottom chord member 3(b) of elongate structural framework members 1 by fastening means 39 and necessary adhesive 40 as shown in Fig. 20. A clip 42 can be used to snap over the flange and lip elements 9(a)/10(a) and 9(b)/10(b) of the bottom chord member 3(b) where fastening means 39 is required centrally.

The foregoing describes only some of the embodiments of the invention and modifications obvious to those skilled in the art can be made thereto without departing from the scope of the present invention.

DATED this TWENTY FIRST day of DECEMBER 1998

BRADBURY FRANK GOLLEDGE	21/12/1998
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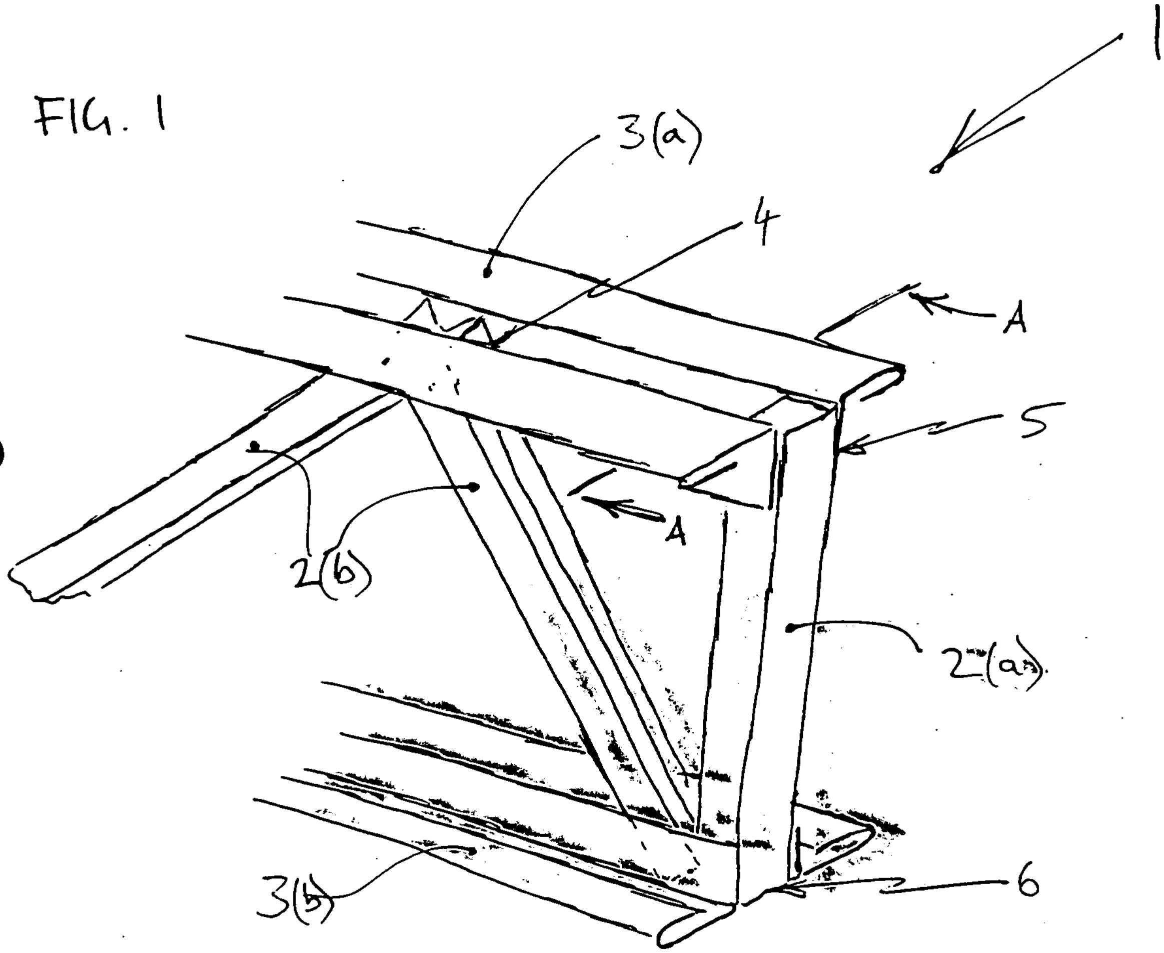
(Name of Applicant) *(BLOCK LETTERS)*	*(Date)*

FIG. 1



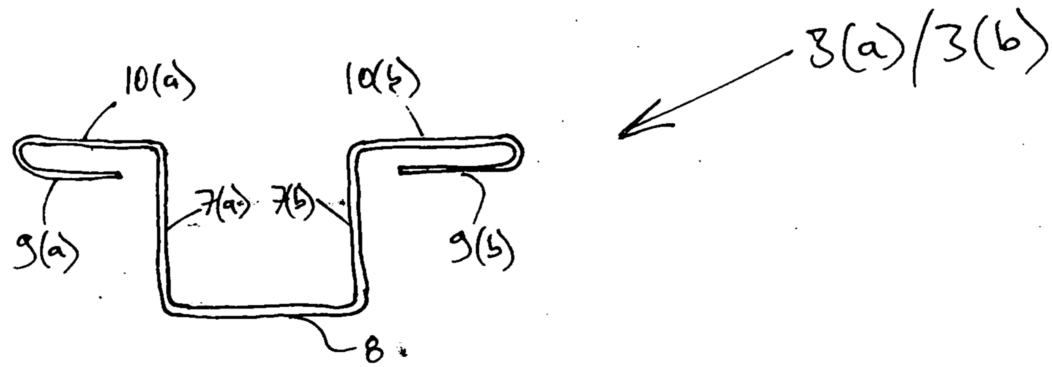


FIG. 2

A - A

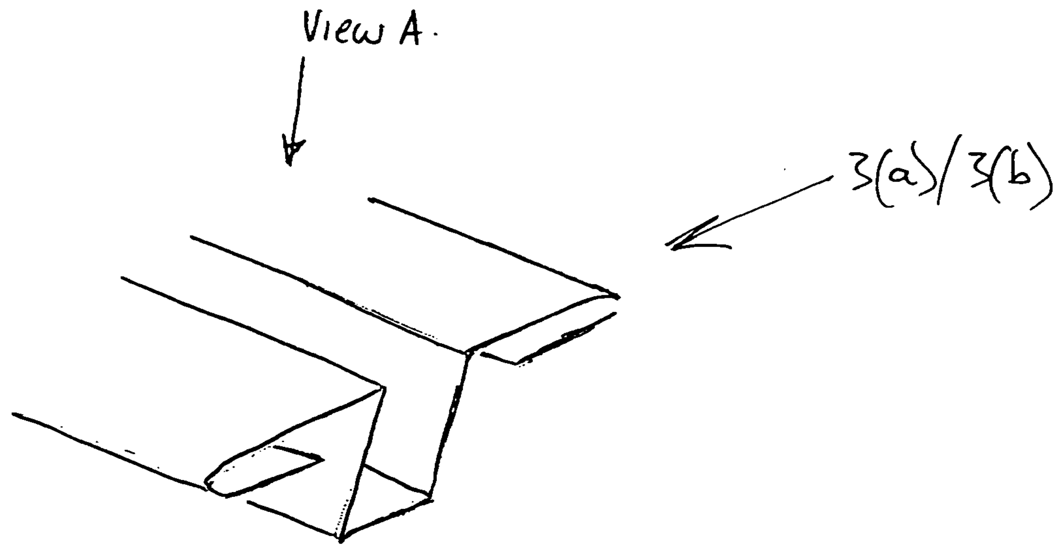


FIG. 3

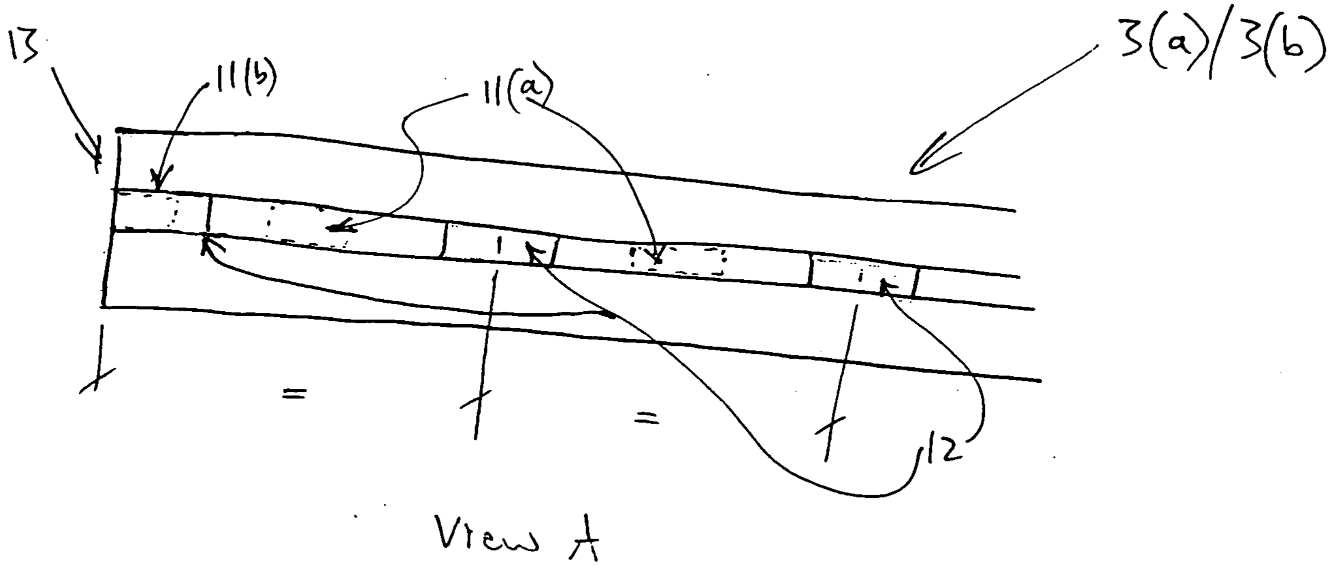


FIG. 4

FIG. 5

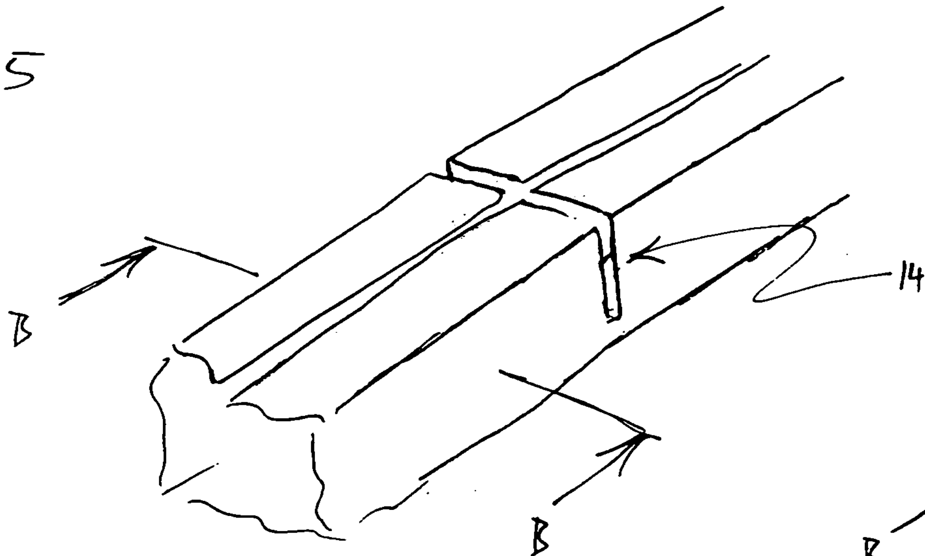


FIG. 6

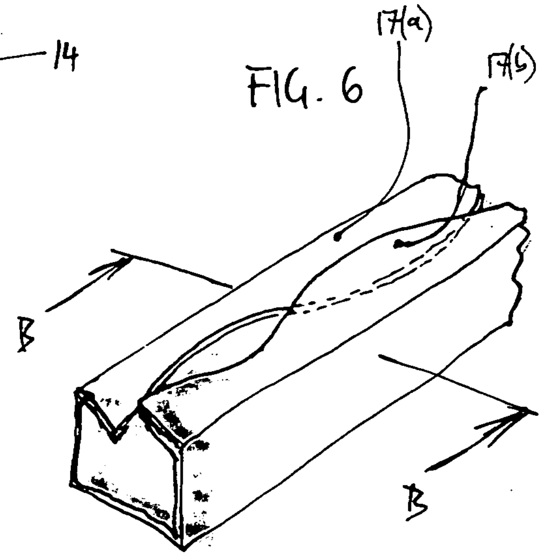


FIG. 8

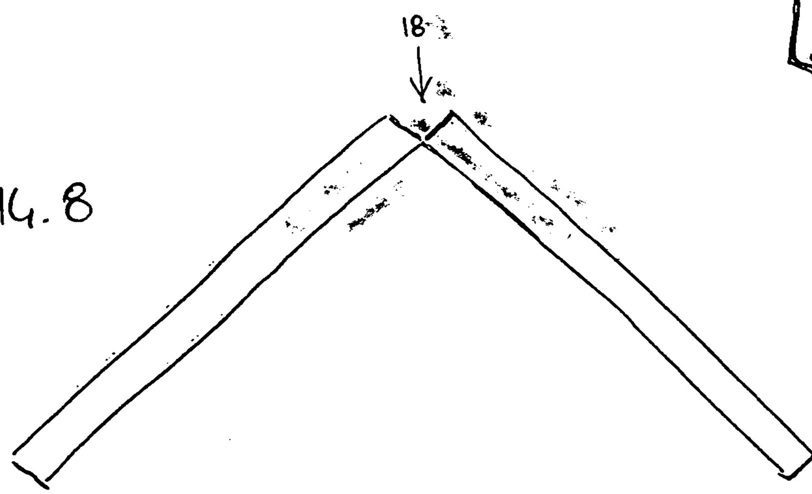
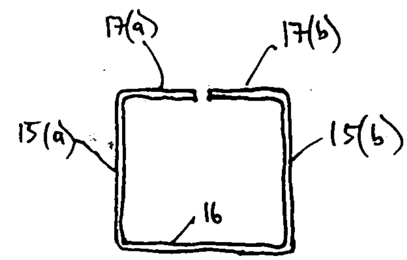


FIG. 7



B - B

FIG. 9(a)

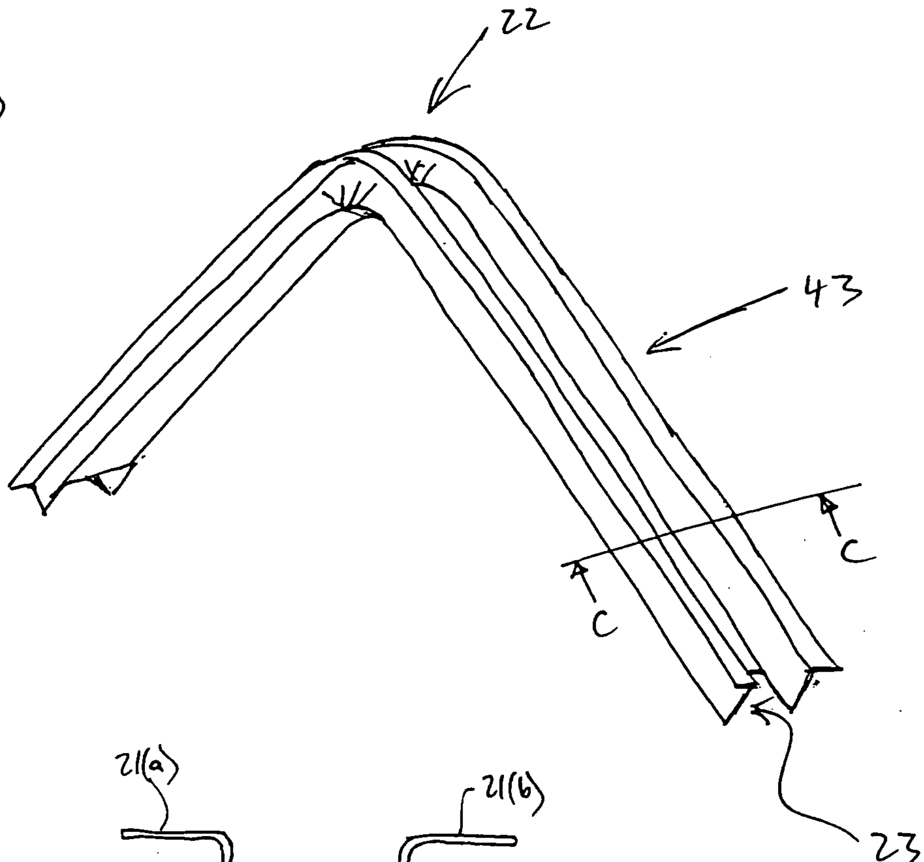
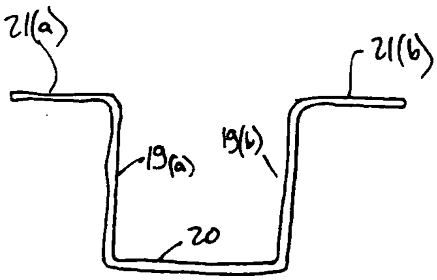


FIG. 10



C-C

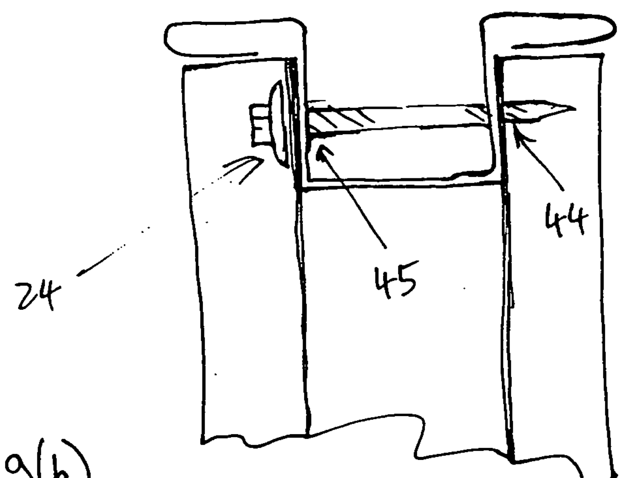


FIG. 9(b)

FIG. 11

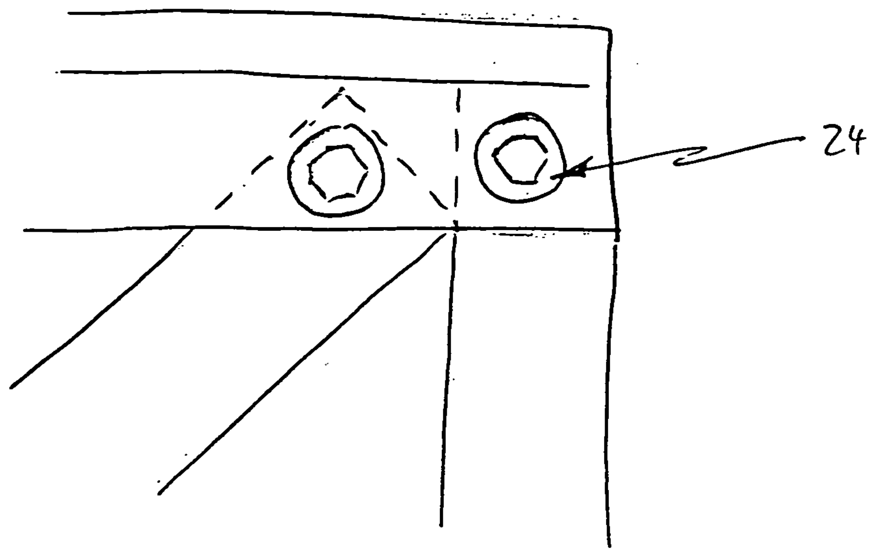


FIG. 12

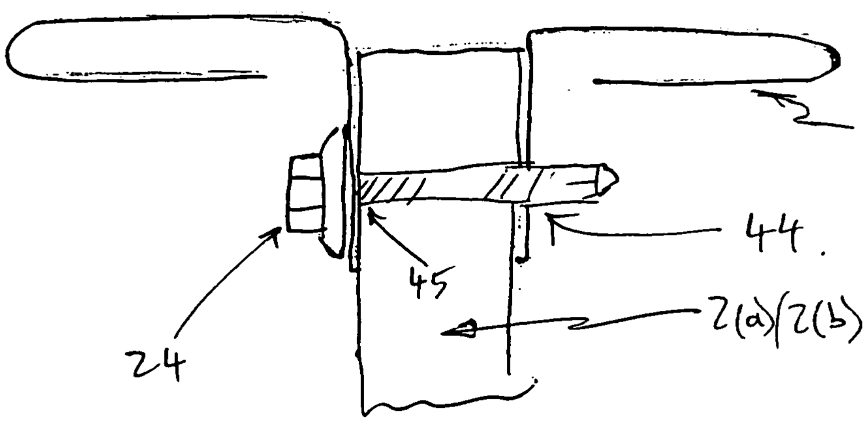


Fig. 13

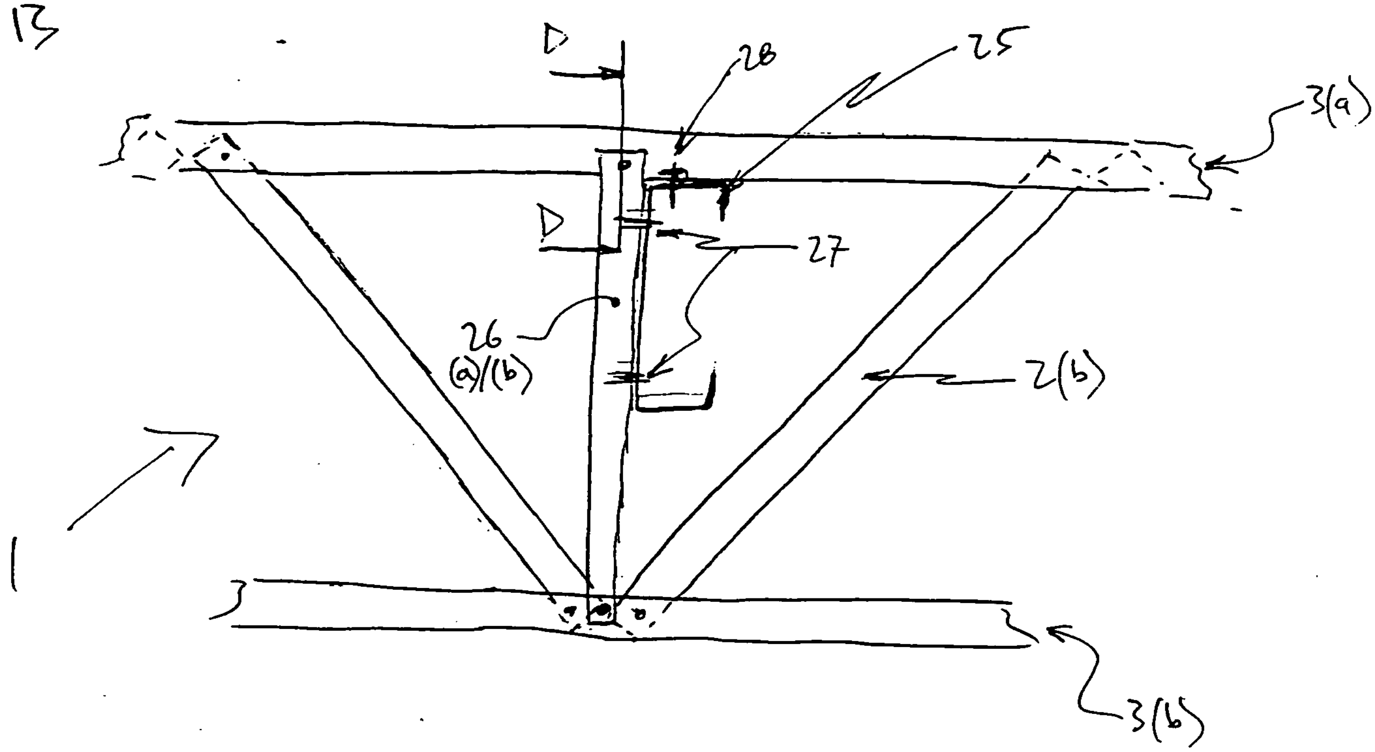
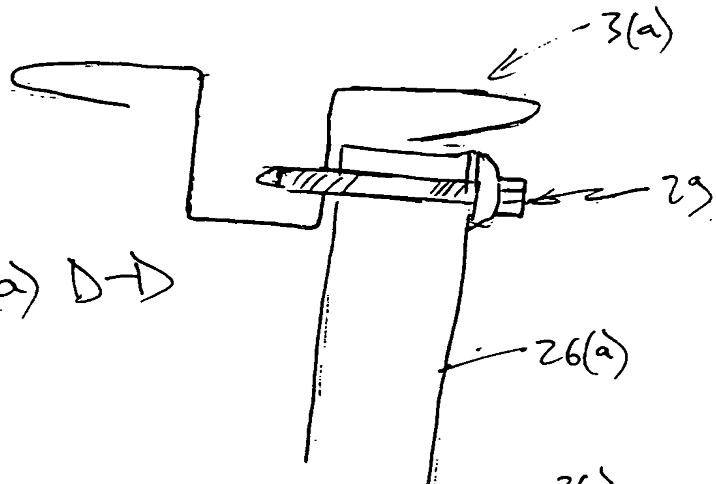
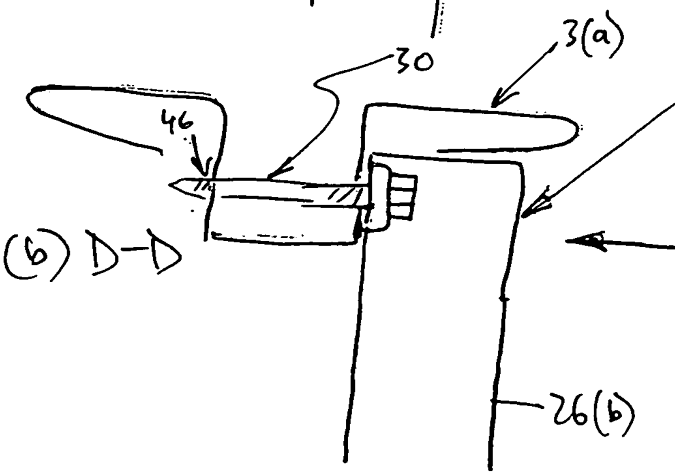


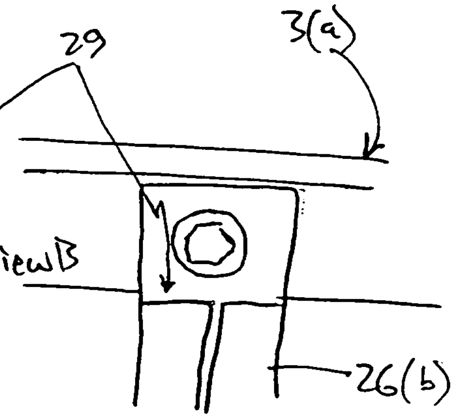
FIG. 14

(a) D-D



(b) D-D





View B

FIG. 15

FIG. 16

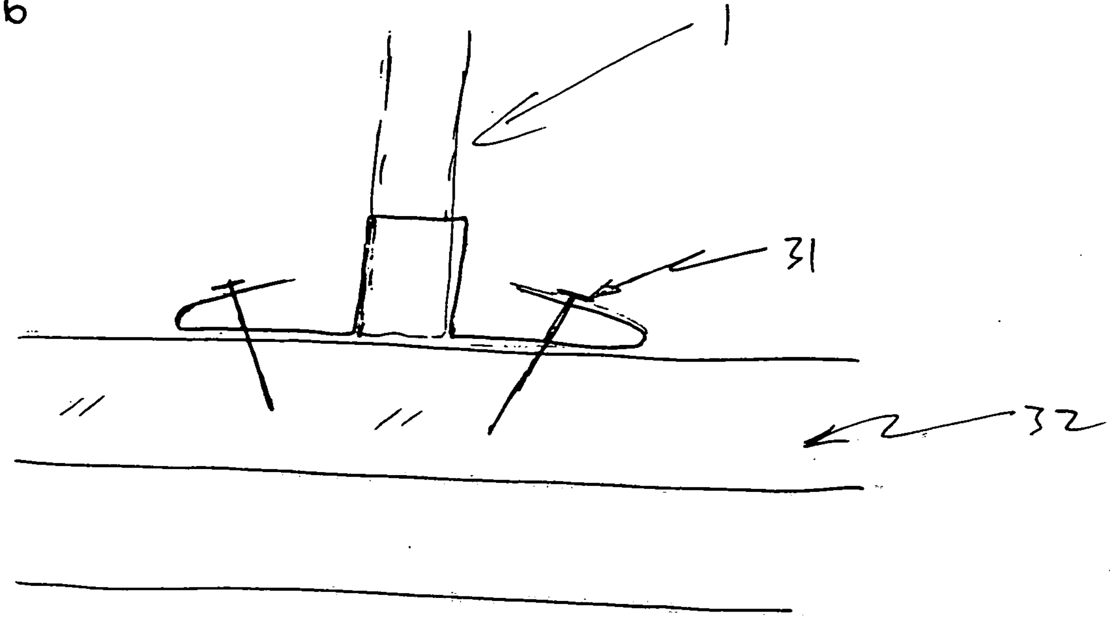
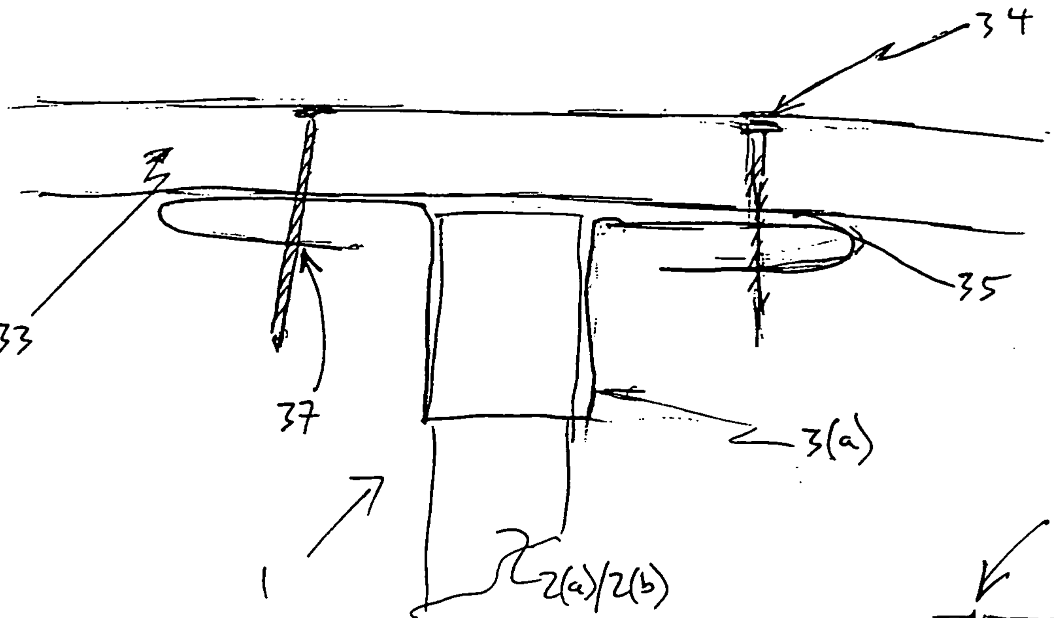


FIG. 17



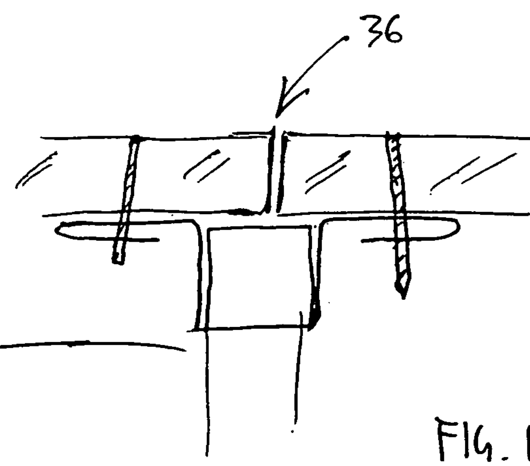


FIG. 18

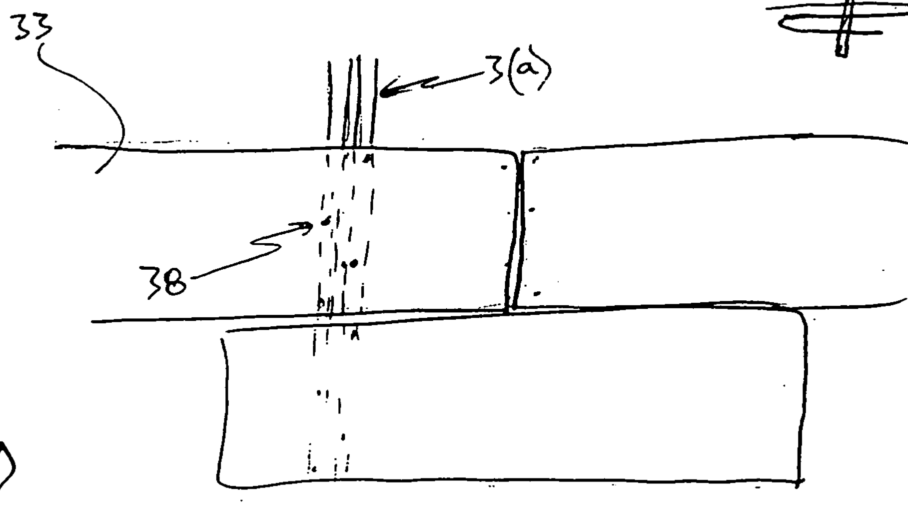
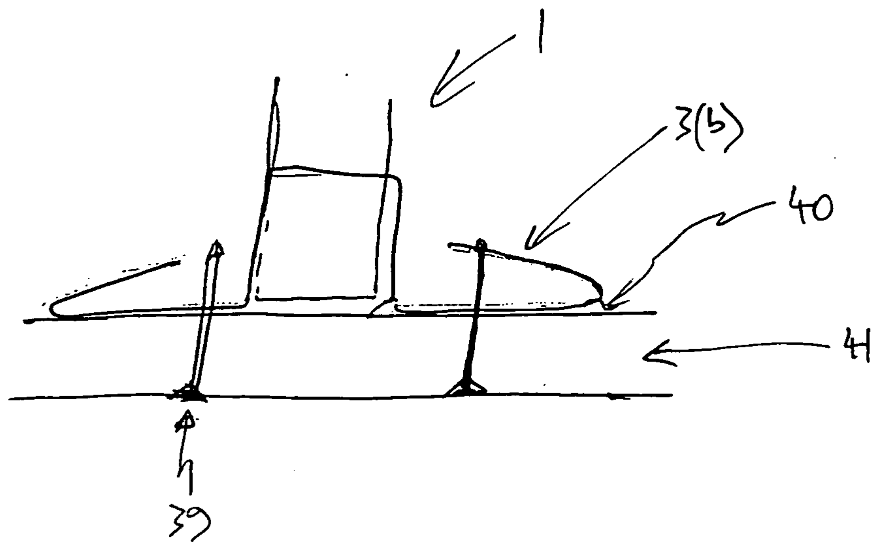


FIG. 19

FIG. 20



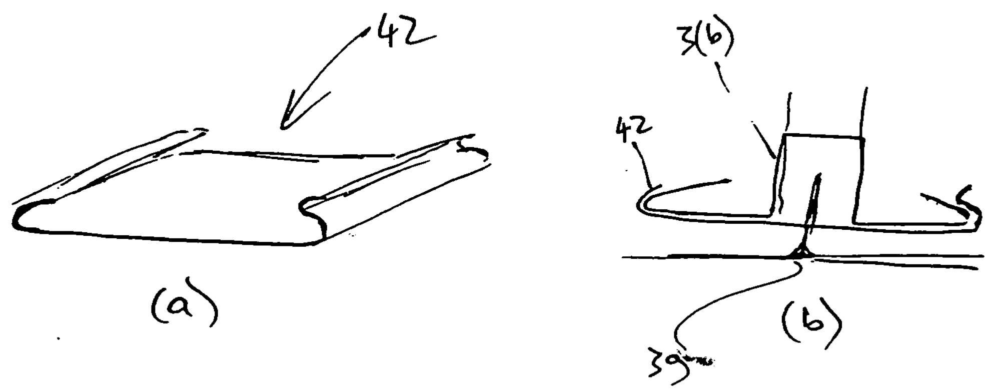


FIG. 21